Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of Spectrum Task Force Request For Information On Frequency Bands Identified By NTIA As Potential Broadband Spectrum	ET Docket No. 10-123

COMMENTS OF QUALCOMM INCORPORATED

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EXECUTIVE SUMMARY

The FCC, NTIA, the Administration, Congress, and the wireless industry all recognize that America is facing a spectrum crunch. There is simply not enough spectrum in the FCC's inventory to meet the mobile data demands of American consumers. Recent estimates warn us that we must be prepared for a 6,000% increase in demand by 2015, driven by smartphones, tablets, and other mobile devices that require anywhere/anytime connectivity. As Qualcomm has explained, to meet these exponentially increasing demands, various parts of the U.S. government and the wireless industry must act rapidly and simultaneously on three parallel paths.

First, Congress should immediately give the FCC legal authority to conduct voluntary incentive auctions, particularly for the broadcast television band. Once the FCC has that authority, the agency may need several years to carry out the auction process and effect the transfer of highly valuable spectrum rights to those parties who value the spectrum the most – the mobile broadband operators – so Congress should act as soon as possible.

Second, while Congress and the FCC implement voluntary incentive auctions, NTIA and the FCC should continue to work together to reallocate additional U.S. government spectrum for mobile broadband as quickly as possible. It would ideal if such spectrum is quickly cleared of all incumbents on a nationwide basis.

Third, as the processes take place both to enable voluntary incentive auctions of commercial spectrum and the realloction of U.S. government spectrum, the industry will not and cannot sit still. In that vein, Qualcomm and its wireless industry partners are working aggressively on next generation technologies to: (1) provide increased capacity for mobile broadband networks operating within the existing mobile broadband spectrum allocations, and (2) enable the deployment of mobile broadband systems in US government bands that are under-utilized, but in which the incumbents cannot be cleared rapidly on a coast-to-coast, 24/7 basis.

Technology alone cannot solve the spectrum crunch, but technology can play a constructive role as one of several parallel strategies to ease the crunch, and technology can enable the use of under-utilized US government bands, once such bands are reallocated for commercial use.

In that vein, Qualcomm is working on a number of technologies that enable the timely deployment of mobile broadband services in underutilized bands. Paired bands that are cleared rapidly coast-to-coast, 24/7, are unquestionably everyone's first choice. But, the good should not be the enemy of the great, and few new bands with those characteristics are available. So, the industry must find new ways to use under-utilized government bands that cannot be cleared nationwide or that cannot be paired with a nationally cleared band. Qualcomm is developing several exciting technologies for that very purpose: Authorized Shared Access, Heterogeneous Networks ("Hetnets"), Supplemental Downlink, and FlashLinq.

Authorized Shared Access ("ASA") is a new technology that will enable the sharing of spectrum within the bands identified by NTIA on a licensed basis. It will allow commercial operators to gain access to the spectrum well before government incumbents permanently relocate – while fully protecting government operations. This is possible because ASA allows licensees only to operate when and where the government is not operating, and with ASA, a commercial operator can vacate spectrum in a matter of seconds when a government user needs to transmit. Because ASA spectrum would be licensed, it allows operators to support a predictable quality of service and develop business plans to build mobile broadband network infrastructure where it is both economically and technically feasible.

Heterogeneous Networks ("Hetnets"). Qualcomm and its wireless industry partners also are actively researching new, denser and more complex mobile broadband network topologies comprised of heterogeneous networks or "hetnets." Hetnets allow smaller cells (comprised of

picocells and femtocells) to operate in an optimized manner within macrocells to achieve greater frequency reuse and increased cellular capacity. Hetnets bring base stations closer to devices through implementation of adaptive interference management and advanced interference cancellation techniques. They will enable commercial mobile broadband operators to use spectrum bands that are higher in frequency than normal cellular bands for smaller cells in geographic areas with especially high mobile broadband usage, and to optimize the use of those cells to gain the utmost in overall network capacity.

Supplemental Downlink. Supplemental downlink technology allows unpaired spectrum bands to be used in a highly efficient manner. This technology delivers dramatically faster mobile broadband downloads and the number of users that can be supported by bonding an unpaired spectrum band with paired spectrum. With this technology, carriers can then use unpaired spectrum in concert with the paired bands in existing mobile broadband networks to deliver a substantially better user experience. Qualcomm is incorporating the supplemental downlink into its chipset roadmap and is developing plans to market the technology globally. Supplemental downlink can and will play an important role in helping wireless operators deal with the increased demand for mobile broadband as consumers continue to buy and use smartphones, tablets, e-readers, and mobile broadband-enabled laptops to access mobile broadband, especially for downloads, wherever they happen to be. And it means that previously under-utilized unpaired bands will become fully utilized.

FlashLinq. Qualcomm developed FlashLinq to provide broadband connectivity among neighborhoods of users in a manner that does not require access to already heavily burdened cellular networks. The technology creates a form of so-called "Proximal Communications" that allows thousands of users and devices within a one kilometer range to discover one another, and

hundreds of users and devices within a several hundred meter range to "sense" the available, interference-free communication channels. Users can then connect, disconnect, and communicate with one other at broadband speeds. In this way, FlashLinq offers a very practical means of using unpaired spectrum for an innovative and spectrally efficient technology. And FlashLinq technology is highly efficient – it uses just 5 MHz of unpaired spectrum to facilitate exceptional peer-to-peer and device-to-device communications.

Each of these technologies – Authorized Shared Access, Hetnets, Supplemental Downlink, and FlashLinq – can be deployed by itself or in combination with one another. By way of example, ASA licensees could deploy Hetnets, Supplemental Downlink and Flashlinq, each in discrete frequency bands but as part of the same network. These technologies, along with the additional spectrum that incentive auctions and government relocation will free, will allow the FCC and NTIA to support America's voracious demand for mobile broadband connectivity and high speed data.

For all the reasons discussed herein, Qualcomm fully supports the efforts and goals of NTIA and the FCC to reallocate as much under-utilized U.S. government spectrum as possible and as rapidly as possible for commercial mobile broadband.

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QUALCOMM Incorporated is pleased to provide the FCC with details on the advanced wireless technologies that it is actively developing to support the timely deployment of new mobile broadband operations in the bands that NTIA and the FCC Spectrum Task Force have identified.[1] As the FCC, the Administration, and Congress all recognize, action is needed now to address America's booming mobile broadband data demands and impending spectrum crunch.[2] New mobile broadband spectrum is, without question, critical to our future economic success.

The evidence is clear: Americans are consuming mobile broadband data at exponentially increasing rates that the current spectrum allocations will soon be unable to support.[3] As explained *supra*, a series of actions must be taken now, in parallel, to ease the spectrum crunch.

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1 *See* FCC Public Notice, DA 11-444, Spectrum Task Force Requests Information On Frequency Bands Identified By NTIA As Potential Broadband Spectrum, ET Docket No. 10-123 (Mar. 8, 2011) (seeking input on use of the bands identified by NTIA for mobile broadband: 1695-1710 MHz, 1755-1780 MHz, 3550-3650 MHz, 4200-4220 MHz, and 4380-4400 MHz).

2 *See* Presidential Memorandum: Unleashing the Wireless Broadband Revolution (June 28, 2010).

3 *See* FCC OBI Technical Paper No. 6, *Mobile Broadband: The Benefits Of Additional Spectrum* (Oct. 21, 2010) at 17-19 ("Even with the conservative … assumptions … in this model, … the nation faces the prospect of a spectrum shortage within the next five years.").

INTRODUCTION

Qualcomm agrees with the FCC and the Administration that there is a pressing need to identify and allocate additional spectrum for mobile broadband use and to do so quickly, for such new allocations are critical to America's future economic success. As FCC Chairman Genachowski has explained, broadband is a core driver of "our economy and our global competitiveness [and] a core accelerator for job growth."[4] Indeed, in 2010, the U.S. technology sector grew almost twice as fast as the overall U.S. economy. Mobile broadband connectivity also is driving efficiencies in all sectors of the American economy from health care and education to energy delivery and product design. Chairman Genachowski rightly warns, "If we don't act [now], we won't have enough spectrum for mobile broadband, [and] that will have real consequences for consumers, who will face declining service, including dropped calls and Internet connections, slow downloads and high prices."[5]

Cisco's 2011 mobile traffic study highlighted a number of remarkable trends in the expected growth of mobile broadband data demand:[6] (i) by 2015, mobile-broadband-enabled tablet computers alone will generate as much traffic as the entire worldwide mobile network generated in 2010; (ii) in 2015, the aggregate traffic generated by smartphones will be 47 times greater than it is today; and (iii) by 2015, machine-to-machine mobile traffic alone will be more than 20% greater than that of the entire global mobile network in 2010.[7] These trends demonstrate the pressing need for the FCC to quickly work with the Administration and

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4 Chairman Genachowski, "The Clock is Ticking," Remarks on Broadband at the Mobile Future Forum (Mar. 16, 2011) at 2.

5 *Id*. at 9.

6 *See Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010–2015* (Feb. 2011).

7 *See id.* at 2-3.

Congress to ensure that the spectrum resources needed to support this demand are identified, auctioned, and allocated within the next few years.

As it has repeatedly stated, Qualcomm fully supports the efforts of the FCC, the Administration, and Congress to give the Commission authority to conduct voluntary incentive auctions to repurpose a significant portion of the spectrum currently occupied by television broadcasters for mobile broadband use.[8]

While wireless technology developers, equipment manufacturers, and mobile broadband service providers are continually improving their networks to make more efficient use of the spectrum currently licensed for mobile broadband operations, network upgrades and technology enhancements alone will not be enough to meet the incredible level of growth in mobile data demand noted above. Additional mobile broadband spectrum – including the government spectrum bands identified by NTIA and the television broadcast spectrum – is absolutely essential. Without new mobile broadband spectrum, there will be "real consequences for innovators looking to build new companies and services on the mobile platform, including life saving health applications, education programs to train our 21st Century workforce, and energy services designed to save our planet."[9] The FCC and NTIA must swiftly work to make as much government spectrum available for mobile broadband use within the next several years so technology developers and equipment makers have time to design and manufacture equipment for deployment in the new spectrum. Identifying additional spectrum for commercial use is critical. But there simply are not enough potentially available bands to meet predicted needs.

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8 *See, e.g.,* Qualcomm Comments on *Dynamic Spectrum Use Notice of Inquiry*, ET Docket No. 10-237 at i, 2 and 14 (filed Feb. 28. 2011); Qualcomm Comments on *Innovation in the Broadcast Television Bands: Allocations, Channel Sharing and Improvements to VHF Notice of Proposed Rulemaking*, ET Docket No. 10-235 (filed Mar. 18, 2011).

9 Chairman Genachowski, "The Clock is Ticking," *supra*, n.4 at 9.

Industry therefore is actively working to make more efficient use of the available mobile broadband spectrum bands. Qualcomm is pleased to discuss herein four technologies that can be deployed in the bands under study by the FCC and NTIA, to improve efficiency and thereby support the ongoing incredible growth in mobile broadband data demand: (i) Authorized Shared Access (or "ASA"); (ii) Hetnets, comprised of macrocells, picocells, and femtocells; (iii) Supplemental Downlink; and (iv) FlashLinq.

ASA is a technology that can be used in conjunction with any 3G or 4G mobile broadband air interface to permit one or more authorized commercial operators to share spectrum assigned to the U.S. government. Importantly, it empowers licensees to respect any geographic, time, and/or frequency restrictions imposed by a government user. Commercial ASA licensees can operate cellular macrocells, picocells, and femtocells, that are location-aware and interface with an ASA dynamic spectrum access controller that knows when and where primary incumbent user(s) are not operating. Because ASA spectrum would be licensed, mobile operators can support a predictable quality of service and develop sound business plans to deploy network infrastructure where it is economically and technically feasible. ASA would allow commercial operators to gain access to government spectrum far more quickly, because it allows partial access well before incumbent government users completely vacate the bands, because of ASA's unique ability to fully protect incumbent government operations.

Heterogeneous networks, or Hetnets, are a second technology that achieves greater frequency reuse and increase cellular network capacity by shrinking cell size. Hetnets improve spectrum efficiency by forming a more dense network topology comprised of picocells (small network cells) and femtocells (end-user premises-based microcells) operating within the same

coverage area as macrocells in a heterogeneous yet seamless fashion. Hetnets can readily incorporate the new bands under study by NTIA and the Commission.

Supplemental Downlink technology is yet another Qualcomm technology that will substantially improve spectral efficiency. It allows mobile operators to bond unpaired spectrum with paired spectrum to substantially improve the mobile broadband user experience by delivering faster downloads and supporting more users, thereby meeting the consumer demand for mobile broadband services that is being driven by the constantly increasing sales of smartphones, tablets, e-readers, and mobile broadband-enabled laptops and laptop dongles.

FlashLinq, uses a 5 MHz unpaired block of spectrum to enable thousands of devices within a one kilometer radius to discover and remain "aware" of one another in a continuous background fashion. This effectively creates a form of mutual awareness in a "neighborhood area network." FlashLinq then enables hundreds of users and devices within a several hundred meter range to continuously connect, disconnect, and directly communicate with one another at broadband speeds. This peer-to-peer technology allows devices to communicate directly without taxing any cellular infrastructure – thus offloading traffic from overburdened cellular networks.

Qualcomm respectfully submits that the FCC and NTIA should carefully consider these innovative technologies, as are described in detail below, because they offer new means of enabling more spectrally efficient mobile broadband data connectivity in the bands identified in the Spectrum Task Force Public Notice.

DISCUSSION

I. Authorized Shared Access Can Fully Protect Government Users In The Identified NTIA Bands And Allow Commercial Operators To Offer Quality Of Service Applications

Spectrum management in the U.S. and around the world generally relies on separating users by frequency band. In the U.S., a large amount of spectrum is reserved for the federal

government. When government bands are reallocated for commercial use, the mobile broadband industry greatly prefers reallocation that grants them access to the band on a 24/7, nationwide basis. This allows industry to make the investments needed to put new paired bands into use for commercial use. But, that is not always possible. For one thing, it may not be possible to clear particular bands of incumbents on a 24/7, nationwide basis within a reasonable time frame. In some cases this is not possible at all.

Qualcomm's ASA technology allows effective use of shared bands in these challenging situations. It does so by allowing one or more commercial ASA licensees to operate in the interstices of underutilized government bands whenever and wherever government users are not using the frequencies. Critically, it ensures that commercial licensees can vacate the band within seconds when government users need to use the spectrum.

As explained in more detail below, ASA will rely upon a database that provides real-time spectrum availability information to the ASA licensee, so that the licensee knows whether it can transmit without interference within a given frequency band at a given time and location.[10] An improved means of sharing spectrum with incumbent users via ASA is one promising means of improving spectrum utilization, because it opens underutilized bands for mobile broadband use while fully protecting incumbent government operations that must be able to continue operating in the band.[11]

An ASA regulatory framework not only allows brings shared bands into use more rapidly, but it also ensures that spectrum use is efficient. It does this by giving government and

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[10] Future implementations of ASA may be augmented through use of spectrum sensing techniques. *Cf.* Unlicensed Operation in the TV Broadcast Bands, Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band, ET Docket Nos. 04-186, 02-380, *Second Memorandum Opinion & Order,* FCC 10-174 at ¶ 54.

[11] *See* FCC Spectrum Task Force Public Notice at 2 (seeking input on means of sharing government bands via coordination in time and geography).

commercial users tools that enable coordinated response to demand spikes. ASA's flexible coordination functions also allows a band to adapt to new technologies and business models more quickly, thereby maximizing consumer value.

ASA licensees can share spectrum with an incumbent (i) by geography or location; (ii) via time sharing, and/or (iii) via frequency band usage sharing. Each sharing technique is available individually or in concert with either or both of the other techniques.

- *Geographical/Location Sharing*. When a primary government user operates in certain geographic areas, it is possible for one or more ASA license holders to use the spectrum in other geographic regions, respecting exclusion zones defined to protect primary government operations. The geographical availability of ASA spectrum also may evolve over time, and increase as incumbent government users' transition out of an ASA band.

- *Time Sharing.* Primary incumbent users that use their assigned spectrum at certain times open the possibility for ASA licensees to use the spectrum during other times. This ASA implementation would work best where primary operations are intermittent.

- *Frequency Band Usage Sharing.* While a primary user currently may hold an allocation to operate across the entirety of a frequency band, it actually may only use a portion of the band. This opens the possibility of providing an ASA licensee access to the unused portions of the frequency band.

To support any one, all, or some combination of the above sharing means, ASA networks in their initial stages would be location-aware and use a Dynamic Spectrum Access ("DSA") Controller. A base station would connect to the ASA DSA controller that would provide information about the available spectrum to ASA network operators so they could manage their spectrum use. The DSA controller would store information about exclusion zones necessary to protect primary incumbent systems in various frequency bands. It also could provide real-time information, such as the potential of using spectrum within an exclusion zone when the primary user is not operating.

A. ASA Can Be Deployed Quickly And Reliably

ASA, at its core, is designed to fully protect incumbent operators. Incumbent government users actually can coexist with ASA licensees on a long-term basis if the government operations permit ASA licensees to access the spectrum resource in areas where there is high demand, such as major metropolitan areas. The technology also can be used to enable access to spectrum for mobile broadband purposes on a rolling basis, for example, while incumbent government users transition to another band. ASA technology also could have the positive effect of encouraging incumbent government users to make more efficient use of the spectrum resource, so broader ASA rights can be auctioned and raise more money for the U.S. Treasury.

ASA accommodates licensed commercial spectrum users' and incumbent government users' interests because it is based on the premise that spectrum rights do not have to be withdrawn from an incumbent user to be granted to another user. From the perspective of the incumbent user, it is essential that the sharing not result in any interference. If interference should occur, the ASA licensee is easily identifiable and would not be permitted to transmit when the spectrum is not available.

Finally, ASA licensees can deploy systems using an established 3G or 4G mobile broadband air interface and implement hetnets comprised of macro/pico/femto cells, Supplemental Downlink technology, or FlashLinq, depending on the restrictions imposed to accommodate incumbents.

B. ASA Is Very Different From The TV White Space Regulatory Framework

There are important differences between ASA and the TV White Space regulatory framework adopted by the Commission. In contrast to sharing in an unlicensed regulatory regime, where multiple uncoordinated users can access the same frequency band at the same

location and time, ASA technology enables a licensed network operator to manage access to the ASA spectrum and thus provide all ASA users with a reliable quality of service. Indeed, because ASA provides a shared spectrum access regime with clearly defined use rights and obligations, it can support higher powered operations better suited to wide-area mobile broadband services that require a predictable quality of service. While unlicensed spectrum, such as the 2.4 GHz and 5 GHz Wi-Fi bands, are well suited for short range, non-overlapping, best-efforts performance, those bands cannot ubiquitously support the predictable quality of service that today's mobile broadband services and applications require over wide areas as well as local areas.

Also, as noted above, ASA gives spectrum use rights to a discrete, identifiable group of operators, as compared to a disparate group of unspecified and unlicensed users. As a result, ASA will fully protect incumbents, and if there are problems with interference caused by sharing, the ASA licensee will be readily identifiable and accountable. For these reasons, ASA offers a promising means of opening additional government bands for wide-area mobile broadband operations, particularly bands that may take many years to completely clear.

II. The Identified Federal Spectrum Bands Can Be Used To Enhance The Network Topology Of Existing Mobile Broadband Networks

Qualcomm also is working on supporting and optimizing a new, denser network topology that would rely upon hetnets. Hetnets use small cells operating within the same coverage area as macrocells. They can readily incorporate new spectrum bands, such as those identified in the FCC Spectrum Task Force Public Notice, to increase capacity. Hetnet cells may include picocells (*i.e.*, small network cells deployed in the external plant) and femtocells (*i.e.*, microcells typically located within the end user premises connected to a DSL, fiber, or cable broadband connection).

Hetnets achieve greater frequency reuse and increase cellular network capacity by shrinking cell size and bringing base stations closer to the end user devices.[12] As Qualcomm demonstrated at the Mobile World Congress earlier this year, hetnets consisting of macro/pico/femto cells rely upon adaptive interference management and interference cancellation in the user equipment, which are additional techniques that Qualcomm and its industry partners are rapidly working to improve.

III. Supplemental Downlink Technology Bonds Unpaired Spectrum To Paired Spectrum Bands To Increase Mobile Broadband Data Capacity

Qualcomm is also preparing to deploy supplemental downlink technology to allow mobile network operators to use under-utilized unpaired spectrum bands to substantially improve the capacity and performance of their mobile broadband networks.[13] Qualcomm expects that supplemental downlink technology will create opportunities in the U.S. and around the world in markets where wireless carriers can integrate unpaired spectrum bands with their existing paired bands to substantially improve mobile broadband data capacity and system performance.

This technology will deliver substantial capacity gains for mobile broadband networks. At the 2011 International CTIA Wireless Show, Qualcomm showcased a live demonstration of this technology showing how a single 5 MHz band enables much faster downloads and substantially increases the number of users that a mobile broadband network can support. In fact, AT&T announced that it intends to deploy supplemental downlink technology in the Lower

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[12] Femtocells require new chipsets rather than standard infrastructure chips, and Qualcomm's chipset roadmap includes chips for femtocells. *See Qualcomm Adds Femtocell Chipsets to Technology Portfolio, Company Will Offer Innovative Solutions Delivering the Broadband Capabilities of 3G to Homes and Offices* (Feb. 16, 2009) *available at* http://www.qualcomm.com/news/releases/2009/02/16/qualcomm-adds-femtocell-chipsets-technology-portfolio.

[13] *See* FCC Spectrum Task Force Public Notice at 2 (seeking comment on new uses for unpaired spectrum bands).

700 MHz spectrum it is acquiring from Qualcomm, and it has said that it will integrate the technology into its longer-term LTE network plans.[14]

IV. Qualcomm's FlashLinq Technology Can Support Highly Efficient Peer-to-Peer Connections On An As-Needed Basis In A Single 5 MHz Unpaired Spectrum Band

Finally, Qualcomm's new FlashLinq technology provides interesting opportunities for the use of any unpaired 5 MHz band of licensed spectrum[15] that becomes available through the NTIA/FCC band restructuring process. FlashLinq allows devices that are near one another to communicate directly without the need to access cellular infrastructure. This new technology allows thousands of devices within a several block radius to discover and remain "aware" of one another in a background fashion, effectively creating mutual awareness in what Qualcomm calls a "neighborhood area network." These devices can then communicate directly at broadband speeds via direct peer-to-peer ("P2P") and device-to-device ("D2D") communications.[16]

FlashLinq creates a form of "Proximal Communications" using OFDMA, whereby mobile users (and devices) can discover each other up to one kilometer away, and then continuously connect, disconnect, and directly communicate with other mobile users (and devices) at broadband speeds at ranges of up to several hundred meters. The technology creates a scalable, distributed "Control Plane" for managing proximal D2D communications involving a

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[14] *See* Qualcomm Press Releases: Qualcomm Announces Agreement for Sale of 700 MHz Spectrum Licenses (Dec. 20, 2010) *available at* http://www.qualcomm.com/news/releases/2010/12/20/qualcomm-announces-agreement-sale-700-mhz-spectrum-licenses *and* AT&T Agrees to Acquire Wireless Spectrum from Qualcomm, Spectrum To Help AT&T Continue To Enhance The Mobile Broadband Experience Nationwide (Dec. 20, 2010) *available at* http://www.qualcomm.com/news/releases/2010/12/20/att-agrees-acquire-wireless-spectrum-qualcomm.

[15] *See* FCC Spectrum Task Force Public Notice (requesting input on potential uses of unpaired spectrum bands).

[16] *See Qualcomm to Demonstrate New Peer-to-Peer Technology at Mobile World Congress* (Feb. 8, 2011) *available at* http://www.qualcomm.com/news/releases/2011/02/08/qualcomm-demonstrate-new-peer-peer-technology-mobile-world-congress.

variety of communication technologies and without burdening already heavily taxed cellular infrastructure.

Here is a summary of how FlashLinq works: Nearby devices "discover" each other using FlashLinq discovery, "estimate" their mutual link quality/path loss as a function of this discovery signal, "sense" their RF proximity and available interference-free communication channels, "infer" the quality of these channels based on their estimated path loss, "exchange" their RF proximity information and communication capabilities (*e.g.*, 3G/4G WAN connectivity, Wi-Fi variants, Bluetooth), "negotiate and agree" on the best means to communicate within that proximity, and subsequently "communicate" on those terms.

All of this occurs directly on a P2P/D2D basis, without burdening the cellular networks. FlashLinq offers countless benefits for consumers and next generation applications in the areas of public safety, education, gaming, and advertising, and enables entirely new types of direct D2D/P2P wireless services. Because FlashLinq communications are proximal (*i.e.*, relatively short range), transmission power levels are kept low, and high levels of spectrum reuse are achieved on par with cellular OFDMA and substantially higher than unlicensed technologies.

FlashLinq devices manage interference in a fully distributed fashion, and there is no substantive difference between mobile devices (*e.g.*, handsets) and fixed devices (*e.g.*, femtocells). Each FlashLinq device can talk with any number of other devices at any time, thereby allowing direct and access-based communications to mix freely. There is no need for any RF planning for FlashLinq. FlashLinq femtocells merely require backhaul (wired or wireless) and an IP address – the remaining radio access network could be an IP infrastructure network, similar to Wi-Fi in this regard – far simpler than that required for cellular femtocells.

CONCLUSION

Mobile broadband spectrum is the lifeblood of today's information economy and the key to ensuring enabling a new, high-performance America that will win the 21st century. New mobile broadband spectrum made available via the joint efforts of NTIA and the FCC as well as incentive auction authority granted by Congress are both needed to realize this important goal.

But skyrocketing demand means that even additional spectrum will not solve the spectrum crisis. The wireless industry is, in parallel, actively working on new technologies to enhance efficiency. Each of the efficiency-enhancing technologies described herein can be deployed in the bands identified by NTIA or in bands already assigned to commercial licensees.

- ASA offers a way to open government spectrum that cannot otherwise be cleared on a 24/7, nationwide basis by enabling it to be shared with licensed commercial users before it can be completely cleared, while fully protecting incumbent government users.

- Hetnets consisting of macrocells, picocells, and femtocells can be implemented in new spectrum to achieve denser network topologies.

- Supplemental downlink can be deployed in previously underutilized unpaired spectrum bands to deliver much faster downloads and to increase the number of users that a network can support.

- And FlashLinq uses an unpaired 5 MHz band to support "neighborhood networks" without taxing precious cellular network resources.

Respectfully submitted,

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